

REMARKS

Review and reconsideration on the merits are requested.

In response to the objection to claim 13 as not further limiting the subject matter of claim 9 from which it depends, Applicants respond as follows.

As recited in claim 13, a filling material filling a hollow portion of the through hole conductors comprises a resin. Claim 9 recites that a filling material fills a hollow portion of the through hole conductors but does not further specify the nature of the filling material. The recitation of claim 13 is different from that portion of claim 9 which recites that a resin material fills the remaining portion of the hole of the conformal vias.

Therefore, it is respectfully submitted that claim 13 further limits claim 9 from which it depends, and withdrawal of the foregoing objection is respectfully requested.

Claims 1-9 and 11-13 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,281,446 to Sakamoto et al. in view of U.S. Patent No. 6,555,762 to Appelt et al. Appelt et al. was cited as teaching through holes and conformal vias comprising metal cylindrical plating and a filling resin. The reason for rejection was that it would have been obvious to use the metal plating and resin filling taught by Appelt et al. as the through hole of the multi-layered circuit board of Sakamoto et al. in order to produce high-density circuitry (citing Appelt et al. at column 6, lines 1-10). The Examiner further considered that it would have been obvious to modify Sakamoto et al. to include the conformal vias of Appelt et al. (as claimed in claims 3 and 9), and that Sakamoto et al. meets the other limitations of the rejected claims relating to arrangement of the vias conductors and through hole conductor.

The independent claims are claims 1, 8 and 9.

In response, claims 1 and 8 have been amended to recite that the via conductors of the connection portion are filled vias, and that the filling material of the through hole has a coefficient of thermal expansion higher than that of the material constituting the filled vias. New claims 14 and 15 further characterize the filled vias as being made of a metallic material.

The above amendment to claims 1 and 8 distinguishes over the combination of Sakamoto et al. and Appelt et al., neither of which discloses the specifically claimed combination of a plated through hole filled with a resin and filled via conductors constituting the connection portion. For example, Fig. 1b of Appelt et al. shows conformal (plated) vias in combination with plated through holes, each filled with core-shell particles generating solid plug 14. Fig. 1 of Sakamoto et al. shows IVH vias together with IVH through holes 14 (in the IVH structure, the electric conductors are formed by filling electrically conductive materials into the IVHs).

As discussed in the REMARKS portion of the Amendment filed May 15, 2006, because the through holes of Sakamoto et al. do not have a filling material comprising a resin filling a hollow portion thereof, Sakamoto et al. is not prone to the problem of the resin filling material having a larger coefficient of thermal expansion than that of the through hole conductor 22 as shown in Figs 3A to 3C of the present specification. That is, there is no corresponding problem to fix in Sakamoto et al. which would lead one of ordinary skill to the invention as defined in claims 1 and 8. Moreover, Sakamoto et al. specifically rejects the use of conformal through holes or vias where a conductor is plated on the inner wall of the through hole or via (column 1, lines 26-30 of Sakamoto et al.). That is, Sakamoto et al. leads away from use of a plated through

hole such as that taught by Appelt et al. in favor of a IVH structure. As described at column 2, lines 53-56, Sakamoto et al. provides an economical and miniaturized multi-layer circuit board by utilizing the advantages of a resinous multi-layer circuit board in which all of the composing layers have IVH structure. Thus, for this additional reason, there is no technical motivation to one of ordinary skill to combine the cited references in the manner suggested by the Examiner.

Independent claim 9 recites that the connection portion is composed of conformal vias so as to distinguish over the multi-layer wiring board of Fig. 1 of Sakamoto et al. where the via-hole conductors are IVH conductors. Further, as discussed above with respect to claims 1 and 8, claim 9 which also requires through hole conductors formed on an inner circumference of the through hole and a filling material filling a hollow portion of the through hole conductors differs from Sakamoto et al. where all of the through holes and via conductors are IVH conductors. Thus, two modifications are required to arrive at the invention of claim 9. Namely, a first modification would require replacing the IVH vias of Sakamoto et al. with the conformal vias of Appelt et al., and a second modification would require replacing the IVH through holes of Sakamoto et al. with the through hole of Appelt et al. having a metal plating and resin filling. The need to make two substantial structural modifications, in addition to the disclosure of Sakamoto et al. which rejects the use of conformal vias and conformal through holes in favor of an IVH structure, shows the unobviousness of the wiring board of present claim 9.

Claim 5, which requires the via conductors on a side of the terminal pad conductor to be further spaced from a center axis of the through hole than the via conductors on a side of the cover-shape conductor portion, is also not met by Sakamoto et al. Particularly, in Fig. 1 of

Sakamoto et al., the via conductor connected to the terminal pad 22 and the third layer from the bottom is closer to the center axis of through hole 14 (formed in the first layer from the bottom) than the via conductor constituting the “connection portion” in the second layer from the bottom. The limitation of claim 5 is also not disclosed by Appelt et al.

Particularly, the Examiner has not explained how the cited prior art meets claim 5. Thus, Applicants respectfully submit that claim 5 is separately patentable over the cited prior art.

For the above reasons, it is respectfully submitted that independent claims 1, 8 and 9 presented herein and the claims depending therefrom are patentable over Sakamoto et al. in view of Appelt et al., and withdrawal of the foregoing rejection under 35 U.S.C. § 103(a) is respectfully requested.

Withdrawal of all rejections and allowance of claims 1, 2 and 4-15 is earnestly solicited.

In the event that the Examiner believes that it may be helpful to advance the prosecution of this application, the Examiner is invited to contact the undersigned at the local Washington, D.C. telephone number indicated below.

AMENDMENT UNDER 37 C.F.R. § 1.111
U.S. Application No. 10/787,406

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Respectfully submitted,



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